UNIQUE WELL CONSTRUCTION IN A WEATHERED PEGMATITE OF THE GEORGIA PIEDMONT

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INTRODUCTION

Groundwater in the Georgia Piedmont is routinely found in the saprolite of the uppermost aquifer and in fractured igneous and metamorphic rocks of the bedrock aquifer. Within the bedrock aquifer, fractures are normally the groundwater migration pathways which yield water to wells. These fractures are open spaces in consolidated rock which can be easily drilled and developed by air rotary drilling. The air rotary technique is the typical drilling method for bedrock wells in the Georgia Piedmont.

This paper describes an abnormal hydrogeological case in which a water-bearing weathered pegmatite was encountered beneath solid rock, and which required a unique well construction to enable the use of the local groundwater. Pegmatite is an igneous rock of hydrothermal origin which has been injected into an existing rock. Pegmatite is usually a consolidated rock and is composed of various minerals and may include quartz, muscovite mica, feldspar and garnet, plus many others.

WELL LOCATION

The well is situated in a prominent topographic draw which is underlain by an interpreted major fracture pattern (Figure 1). This fracture pattern was interpreted by topographic and aerial photographic methods. It was further delineated by an electrical resistivity survey of the area. A major water-bearing zone within the bedrock aquifer between approximately 75 and 110 feet deep was interpreted to exist. Other minor water-bearing fractures were interpreted to exist beneath the major zone.

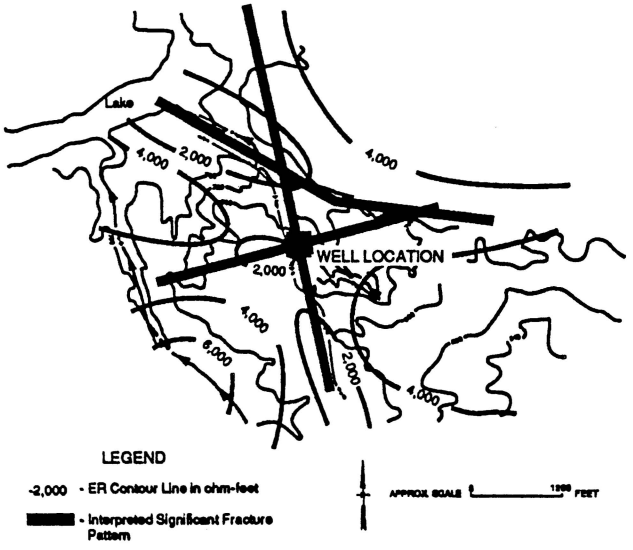

Figure 1. Well Location and Electrical Resistivity Survey Interpretation.

WELL DRILLING

Air rotary drilling with an 11-inch diameter roller cone bit was utilized through the clay saprolite and 2 feet into solid bedrock (Schist). Six-inch PVC casing was installed and cemented in place which is normal for this type of well (Figure 2). Air rotary drilling continued beneath the casing into solid rock with a 5 1/2-inch diameter downhole hammer bit.

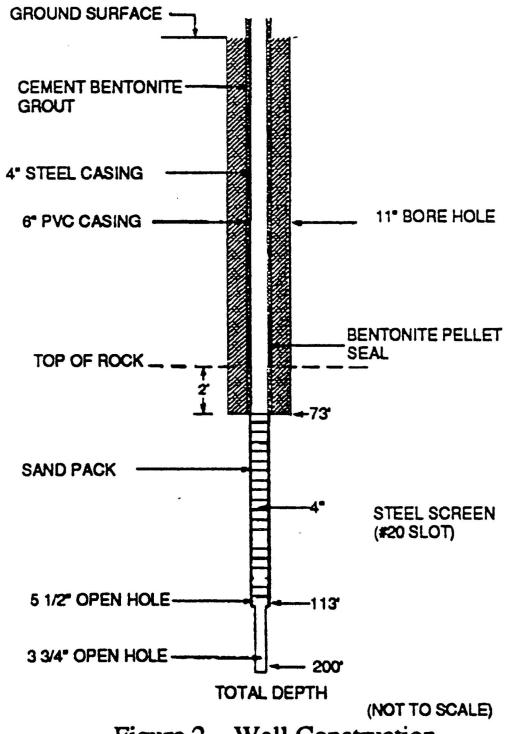

Figure 2. Well Construction

At 75 feet deep, the weathered pegmatite was encountered; air rotary drilling could not keep the collapsing sediment from the open hole while advancing the bit. At this point, mud rotary drilling, which is not normally used in the Piedmont, had to be employed to keep the hole open with a wall cake of bentonite

drilling mud. Bentonite swells when saturated and when properly mixed with water and used as the drilling fluid will create a wall cake in the hole thereby stabilizing the unconsolidated sediment in the pegmatite.

At 110 feet deep, consolidated rock was once again encountered which remained open without drilling mud. A 4-inch diameter wire-wrapped low carbon steel screen was installed opposite the pegmatite. The screen openings were 0.020 inch wide; the screen bottom was left open and 4-inch diameter steel casing was threaded and coupled to the top of the screen. Casing extended up to the ground surface.

A coarse sand pack was placed in the annular space between the screen and the wall of the hole and was filled to a height 2 feet above the top of the screen. A 2-foot thick bentonite pellet seal was placed on top of the sand pack followed by cement/bentonite grout to the surface. The screen was developed by water jetting and air surging to remove the drilling mud and fine sediment just outside the sand pack.

Following well development, another drilling rig with smaller diameter drill rods (2 7/8-inch diameter) had to be mobilized to the site. The original rig had 4-inch diameter rods and could not pass through the screen. The new rig drilled the remainder of the well with a 3 3/4-inch diameter downhole hammer bit to a total depth of 200 feet. Minor fractures were encountered at 120, 135, 155, 165, and 180 feet deep. The caliper log of the completed well details the fracture locations (Figure 3). The well yielded 20 gallons per minute of clear groundwater, a majority of which was developed from the screened pegmatite zone. The fractures beneath the pegmatite yielded a relatively minor amount of water.

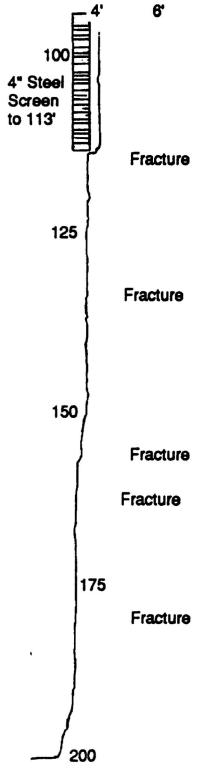

Figure 3. Caliper Log

SUMMARY

The Piedmont of Georgia contains relatively abundant yet localized groundwater resources. Typically air rotary drilling is utilized to drill wells into fractured bedrock, and typically, if subsurface conditions cause collapsing problems, the well is usually abandoned. The unconsolidated sediments that cause the problem are usually also the zones from which groundwater can be obtained.

In abnormal cases such as the pegmatite in this case, a Georgia Coastal Plain drilling technique (mud rotary) can be applied to successfully complete the well. A combination of air rotary and mud rotary drilling techniques was applied in this case to successfully complete the well and to enable the local groundwater to be utilized.